Nonoperative Treatment of Thoracic and Lumbar Spine Fractures

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Published in:
Journal of Orthopaedic Trauma

Nonoperative Treatment of Thoracic and Lumbar Spine Fractures: A Prospective Randomized Study of Different Treatment Options

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Objectives: To evaluate and compare nonoperative treatment methods for traumatic thoracic and lumbar compression fractures and burst fractures.

Design: Prospective randomized controlled trial with long-term follow-up.

Setting: Two general hospitals in the Netherlands.

Patients/Participants: Patients with a traumatic thoracic or lumbar spine fracture, without neurologic damage, with less than 50% loss of height of the anterior column and less than 30% reduction of the spinal canal were included.

Intervention: Patients in the compression group were randomized to physical therapy and postural instructions, a brace for 6 weeks, or a Plaster of Paris cast for 6 or 12 weeks. Patients in the burst group received a brace or a Plaster of Paris cast, both for 12 weeks.

Main Outcome Measurements: Follow-up examinations included radiographs, Visual Analogue Scores for toleration of treatment and persistent pain, and an Oswestry Disability Index at long-term follow-up.

Results: There were 133 patients: 108 in the compression group and 25 in the burst group. For compression fractures, physical therapy and brace were considered the most tolerable. Brace therapy scored significantly better on the Visual Analogue Scores for residual pain and on the Oswestry Disability Index. None of the treatments had any significant effect on the residual deformity measurements. For burst fractures, no significant differences were found.

Conclusions: Brace treatment with supplementary physical therapy is the treatment of choice for patients with compression fractures of the thoracic and lumbar spine. Furthermore, more than 20% of all patients had moderate or severe back pain at long-term follow-up.

Key Words: thoracic and lumbar fractures, randomized clinical trial, nonoperative treatment, clinical outcome measures, residual pain

(*J Orthop Trauma* 2009;23:588–594)

Accepted for publication February 18, 2009.

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The authors like to state that because of the inclusion period from 1991 to 1997, immobilization in a plaster of Paris, brace, or no immobilization were compared as treatment options. Vertebroplasty and kyphoplasty were not considered a treatment modality in that period.

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INTRODUCTION

Nonoperative treatment for thoracic or lumbar anterior wedge compression type and stable burst spine fractures is considered to be safe with an acceptable long-term outcome concerning pain, employability, and residual deformity for the majority of patients.[1–6] Treatment options vary from bed rest, via the use of various orthoses, to functional treatment with postural instructions by physiotherapists.[4,7–10] However, there is no consensus in the literature about the optimal treatment. There is also a paucity of direct evidence of the effectiveness of any of the different treatment schemes, although Shen and Shen[5] and Mehta et al[11] referred to research done by Patwardhan et al[12] in which the stabilizing value of a Jewett hyperextension orthosis appeared to depend on the initial post-trauma segmental stiffness. They concluded from their own studies that it was not necessary to wear a brace as this provided no additional therapeutic benefit. Despite these reports and the tendency to treat these injuries usually with "benign neglect," every spine surgeon knows cases of dissatisfied patients with substantial residual pain after different kinds of nonoperative treatment schemes who occasionally require operative intervention.[13] To try and identify the optimal method of nonoperative treatment, we conducted a prospective randomized comparison of 4 treatment options for compression fractures (AO type A1 and A2) and 2 for burst fractures (AO type A3).[14] As far as we are aware, such a long-term study has not been previously reported.

PATIENTS AND METHODS

The study was carried out in 2 general hospitals in Amsterdam. Patients were enrolled from July 1991 until March 1997. Inclusion criteria were patients with a traumatic thoracic or lumbar fracture without neurologic impairment and younger than 80 years. Only fractures with less than 50% loss of anterior height, with less than 30% reduction of the spinal canal, and without signs of posterior element involvement were included.

There were 133 patients: 72 (54.1 %) women and 61 (45.9%) men. Patients were admitted to hospital after initial radiographs had been made. A computed tomography scan was performed within 48 hours of admission in all cases. The fractures were classified according to the AO classification, and the severity of trauma, high or low energy, was also assessed. Bed rest was prescribed for the first 3–5 days depending on pain and general condition. After written informed consent had been given, patients were randomized to one of the following treatments for compression fractures: (1) physical therapy alone for 6 weeks, (2) thermoplastic removable brace for 6 weeks, and (3) plaster of Paris (POP) cast for 6 or (4) 12 weeks. For burst fractures, thermoplastic removable brace was compared with POP cast, both for 12 weeks. All patients treated with orthoses also received physical therapy, and in the compression group, braces were allowed to be removed at night. Discharge followed after adequate mobilization.

Table 1 shows the demographic data of the patients after randomization into treatment groups.

Follow-up was planned at 6 and 12 weeks and 6 and 12 months with at least 1 long-term follow-up visit minimally 1 year later. Initially, the study focused also on radiological parameters: 5 measurements were made on the supine lateral radiographs, that is, the C1 (actual Cobb angle[15]) between the superior end plate of the vertebrae above and the inferior end plate of the vertebrae below the fractured level; the C2, which is the wedge angle of the affected vertebra; the C3 measuring the wedge angle of the fractured vertebra and adjacent intervertebral discs of the fractured vertebra; the C4, which is the ratio between the heights of the anterior and posterior parts of the vertebral body; and the C5 angle, which includes the fractured vertebra and the superior intervertebral disc (Fig. 1).

Radiologic deformity, residual pain, and functional outcome were set as primary outcome parameters. At follow-up, patients were also asked about any pretrauma back pain and disability. At the long-term follow-up visit, Visual Analogue Scores (VAS) were used to assess toleration of treatment (0 = easily tolerated, 100 = intolerable) and residual pain (0 = no pain, 100 = unbearable pain), and an Oswestry Disability Index (ODI) was calculated.[16]

Because the majority of the fractures occurred at the thoracolumbar junction (T11-L2), we also evaluated these patients separately. In addition, analyses were repeated after exclusion of postmenopausal patients because this may be an independent parameter.

A power analysis beforehand was performed on the basis of a presumed difference in kyphosis angle of 5 degrees as significant difference (alpha 0.05, beta 0.20, SD 10), which required 22 patients per group. Statistical analyses were performed with SPSS 11.0 (SPSS Inc, Chicago, IL) to compare the different treatment schemes; compression and burst fractures were analyzed separately. Using an independent sample *t* test, mean differences in C measurements, VAS, and ODI between 2 treatments at a time were determined at follow-up inclusive of 95% confidence intervals (CI). Post hoc analyses were not conducted. A *P* value of less than 0.05 was considered significant. Power and sample size calculation was performed. In addition, possible prognostic factors for persistent back pain and disability were looked for with multivariate analysis.

RESULTS

In total, there were 133 patients: 108 compression fractures, 22 burst fractures, and 3 patients with both compression and burst fractures. Patients who had both compression and burst fractures were allocated to the burst fracture group, making a total of 25 patients in this group (Table 1).

Table 2 shows the number of fractures, subdivided according to the AO classification, in each treatment group. The "split" (A2.2) fractures were included with the compression fractures for treatment as, regarding their severity, they seemed more like these than like the burst fractures. One B1.2 fracture was included in the burst fracture group because there was only minimal posterior disruption. Twenty patients had 2 compression fractures, 1 patient 2 burst fractures, 2 patients a compression and burst fracture and, 1 patient 2 compression fractures and 1 burst fracture. This gave a total of 158 thoracic and lumbar spine fractures: 132 were compression fractures (A1/ A2) and 26 were burst fractures (A3+B1).

The fracture level varied from Th3 to L5, 74% of the fractures were at the thoracolumbar junction (T11–L2), 15 % exclusively thoracic, and 11% lumbar localized.

TABLE 1. Patient Demographic Data

	Compression Fractures					Burst Fractures		
	n	Physical Therapy	Brace for 6 Wk	POP for 6 Wk	POP for 12 Wk	n	Brace for 12 Wk	POP for 12 Wk
No. patients (%)	108	29 (27)	29 (27)	27 (25)	23 (21)	25	9 (36)	16 (64)
Gender—male, %	45	48	45	48	39	48	56	44
Mean age, yrs (range)	47 (18–76)	50 (21–70)	46 (19–69)	48 (18–75)	45 (18–76)	47 (21–73)	45 (21–64)	48 (26–73)
Male	43 (18–75)	47 (21–70)	39 (19–64)	46 (18–75)	38 (24–71)	44 (21–71)	36* (21–59)	49 (27–71)
Female	51 (20–76	52 (24–70)	52 (26–69)	50 (22–68)	49 (20–76)	51 (26–73)	57 (46–64)	48 (26–73)
Mean admission time, d	8.8 (0–60)	9.7 (0–60)	8.8 (0–21)	8.3 (0–27)	8.9 (0–60)	12.5 (0–25)	12.4 (6–21)	12.6 (0–49)
High-energy trauma, %	82	86	86	85	78	80	89	75

*Statistically significant.

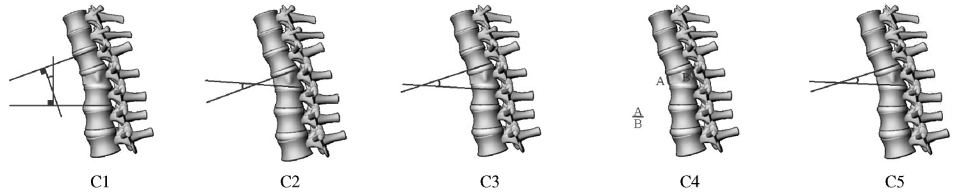

FIGURE 1. Different kyphosis measurements.

For compression fractures, there were no significant differences regarding sex, age, high-energy trauma, and admission time between the different treatment schemes. For patients with burst fractures treated with a brace, the mean ages of men (36 years) and women (57 years) showed a significant difference with a mean difference of 21.7 years and a CI of 1.8–41.5, as women were older than men (n = 9).

Twenty-seven women (38%) were postmenopausal with a mean of 10.4 years (range 0–30 years) between menopause and fracture. Twenty-one (78%) of these women did have a high-energy trauma, and they were all equally distributed among treatment groups ($\gamma 2$ $P = 0.25$).

Thirty-two patients (24%), when asked, reported pretrauma episodes of back pain, only 2 patients actually had elevated ODIs of 7 and 20 at the time of admission, the remainder did not. Although planned follow-up was at 6 and 12 weeks and 6 and 12 months and long-term follow-ups in 1998 and 2003, not all patients attended on all occasions. In 1998, a clinical and radiological long-term follow-up was carried out on 67.4% of the patients. At this time, 2 patients had died of unrelated causes and could not be included in the follow-up. In 2003, by means of telephone calls and questionnaires, follow-up was possible in 61%, corrected for the 14 patients who, by then, had died. Eleven patients who could not be traced in 1998 were contacted in 2003. Using a paired sample *t* test, we compared the VAS and ODI scores from 1998 with those from 2003 and concluded that there were no significant differences. We therefore combined the scores from 1998 and 2003 for the VAS and ODI for long-term follow-up. This gave a long-term follow-up percentage for 1998/2003 of 75.4%. The mean follow-up period was 7.11 years with a range of 1–12 years (SD 3.0).

Radiologic Measurements

Table 3 shows the mean C measurements made on the lateral radiographs directly after the trauma, 1 year later, and at the first long-term follow-up in 1998. The mean measurements and individual treatment methods are presented. There were no significant differences between treatment groups at trauma, 1-year follow-up, and follow-up in 1998, also because of the large SDs. Within each treatment group, the kyphosis measurements at trauma and follow-up did not show any significant differences; in particular, there was no deterioration of the kyphosis angles.

VAS and ODI Scores

For the treatment of compression fractures, physical therapy was tolerated better than a POP for 6 and 12 weeks (mean difference 33.9, CI of 16.6–51.3, calculated power 0.97; mean difference 21.6, CI 3.4–39.8, calculated power 0.81). Brace therapy was tolerated better than a POP for 6 weeks with a mean difference of 21.6 less on the VAS scale (CI 5.8–37.4, calculated power 0.77) (Fig. 2).

For the VAS score for residual pain, a brace was significantly better than a POP for 12 weeks (mean difference 19.0, CI 1.87–36.2, calculated power 0.60) (Fig. 3).

The ODI showed a significant difference in favor of brace therapy compared with a POP for 12 weeks (mean difference 10.1, CI 0.25–20.0, calculated power 0.57) and physical therapy (mean difference 14.9, CI 2.7–27.1, calculated power 0.70) (Fig. 4). These significant differences are summarized in Table 4.

When only patients with compression fractures of the thoracolumbar junction (n = 79) were analyzed, there were no significant differences regarding toleration of treatment. The VAS for residual pain was significantly lower after brace therapy compared with POP for 12 weeks (mean difference 28.1, CI 10.5–45.8) and POP for 6 weeks compared with POP for 12 weeks (mean difference 28.4, CI 9.6–47.3). The ODI was significantly lower after brace therapy than after physical therapy only (mean difference 26.9, CI 11.4–42.3), POP for 6 weeks (mean difference 7.7, CI 0.35–15.0) and POP for 12 weeks (mean difference 14.4, CI 0.63–26.1). Also, there was a significant difference in favor of POP for 6 weeks

TABLE 2. Treatment Randomization and Fracture Classification (AO), and Total Number of Fractures

	AO								
	A1.1	A1.2	A1.3	A2.2	A3.1	A3.2	A3.3	B1.2	Total
Physical therapy	4	30	1	1	—	—	—	—	36
Brace for 6 wk	2	28	2	—	—	—	—	—	32
POP for 6 wk	1	29	2	1	—	—	—	—	33
POP for 12 wk	1	28	2	—	—	—	—	—	31
Brace for 12 wk	—	—	—	—	4	6	—	—	10
POP for 12 wk for burst fracture	—	—	—	—	7	4	4	1	16
Total	8	115	7	2	11	10	4	1	158

TABLE 3. Mean Measurements Compression and Burst Fractures (degrees)

	Compression Trauma	1 Yr	Last FU		Burst Trauma	1 Year	Last FU
C1 mean (SD)	7.7 (11.9)	9.3 (14.1)	7.2 (10.8)	C1 mean	11.8 (8.4)	8.3 (12.3)	11.8 (9.5)
Physiotherapy	6.8 (13.6)	7.9 (10.2)	3.8 (17.5)	Brace 12	12.6 (6.2)	9.5 (10.4)	12.3 (10.8)
Brace	6.4 (14.6)	12.0 (14.0)	7.9 (12.9)	POP 12	11.2 (10.0)	7.5 (13.8)	11.2 (9.1)
POP for 6 wk	9.4 (9.6)	10.6 (10.5)	8.7 (11.0)	—	—	—	—
POP for 12 wk	8.3 (8.9)	9.3 (21.2)	7.7 (11.4)	—	—	—	—
C2 mean	9.9 (5.2)	12.3 (7.3)	11.0 (6.0)	C2 mean	12.2 (7.1)	13.2 (6.9)	11.8 (6.1)
Physiotherapy	9.1 (6.0)	10.1 (12.4)	9.5 (8.1)	Brace 12	13.2 (4.2)	15.0 (6.6)	10.6 (7.9)
Brace	10.5 (4.5)	14.2 (5.8)	11.6 (5.1)	POP 12	11.4 (9.1)	12.0 (7.1)	13.3 (2.6)
POP for 6 wk	9.9 (5.6)	11.9 (5.2)	11.5 (5.2)	—	—	—	—
POP for 12 wk	10.1 (4.7)	12.0 (4.4)	10.4 (5.4)	—	—	—	—
C3 mean	3.1 (9.6)	4.0 (11.7)	2.0 (11.8)	C3 mean	5.9 (6.4)	4.3 (7.3)	4.0 (7.0)
Physiotherapy	2.4 (13.4)	1.5 (8.8)	–1.4 (16.1)	Brace 12	4.3 (7.3)	4.0 (9.5)	5.0 (7.2)
Brace	2.3 (7.2)	5.2 (8.1)	3.9 (8.6)	POP 12	7.4 (5.4)	4.5 (5.9)	2.8 (7.2)
POP for 6 wk	5.5 (8.0)	5.0 (10.9)	4.7 (10.0)	—	—	—	—
POP for 12 wk	2.7 (8.7)	6.8 (16.0)	0.8 (11.6)	—	—	—	—
C4 mean	0.8 (0.1)	0.7 (013)	0.8 (0.13)	C4 mean	0.73 (0.14)	0.67 (0.18)	0.69 (0.17)
Physiotherapy	0.78 (0.09)	0.72 (0.16)	0.77 (0.12)	Brace 12	0.71 (0.10)	0.62 (0.19)	0.71 (0.23)
Brace	0.77 (0.08)	0.68 (0.12)	0.71 (0.15)	POP 12	0.75 (0.17)	0.71 (0.16)	0.67 (0.09)
POP for 6 wk	0.78 (0.1)	0.74 (0.14)	0.74 (0.11)	—	—	—	—
POP for 12 wk	0.76 (0.15)	0.70 (0.17)	0.78 (0.12)	—	—	—	—
C5 mean	7.7 (7.3)	10.4 (9.6)	8.6 (9.5)	C5 mean	10.3 (7.2)	11.6 (8.3)	9.2 (6.7)
Physiotherapy	8.8 (9.7)	9.8 (7.0)	6.2 (13.3)	Brace 12	9.0 (5.5)	12.6 (7.9)	8.1 (8.6)
Brace	5.5 (5.3)	11.1 (6.9)	9.6 (7.1)	POP 12	11.5 (8.5)	10.9 (8.9)	10.3 (3.9)
POP for 6 wk	8.6 (5.9)	10.0 (9.1)	9.9 (8.0)	—	—	—	—
POP for 12 wk	7.6 (6.9)	10.9 (14.6)	8.2 (9.0)	—	—	—	—

FU, follow-up.

compared with physical therapy (mean difference 19.2, CI 3.8–34.7) (Table 5).

After excluding postmenopausal women from the total compression fracture population (n = 81), physical therapy was tolerated better than a POP for 6 weeks (mean difference 28, CI 4.8–52.5). The VAS for residual pain did not show significant differences. The ODI was significantly lower for brace therapy compared with physiotherapy (mean difference 19.1, CI 3.3–35.0), a POP for 6 weeks (mean difference 8.8, CI 0.65–17) and a POP for 12 weeks (mean difference 13.9, CI 2.8–24.9) (Table 6).

For burst fractures, the VAS and ODI scores were both worse than those for the compression group and did not show any significant differences between treatments.

In the compression fracture group, 20 patients (18%) had a VAS score for persistent pain of greater than 50 (moderate pain), and 10 (9%) of these had a VAS score of >70, which implies severe pain. Twelve patients (11%) in

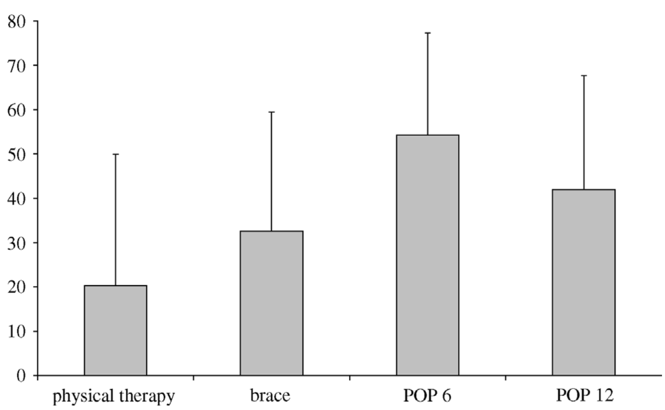

FIGURE 2. Compression fractures, all patients: mean VAS toleration of treatment (0 = easily tolerated, 100 = intolerable).

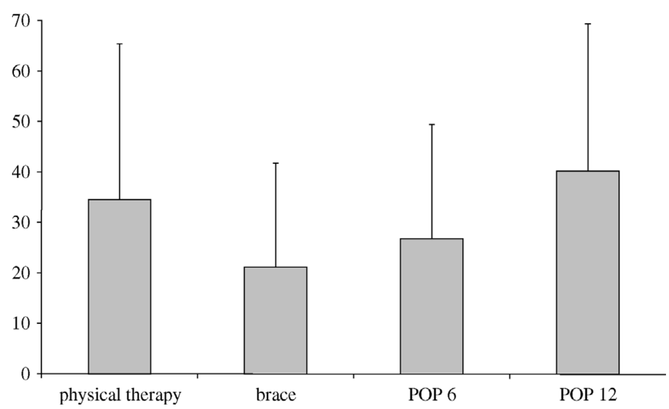

FIGURE 3. Compression fractures, all patients: mean VAS residual pain.

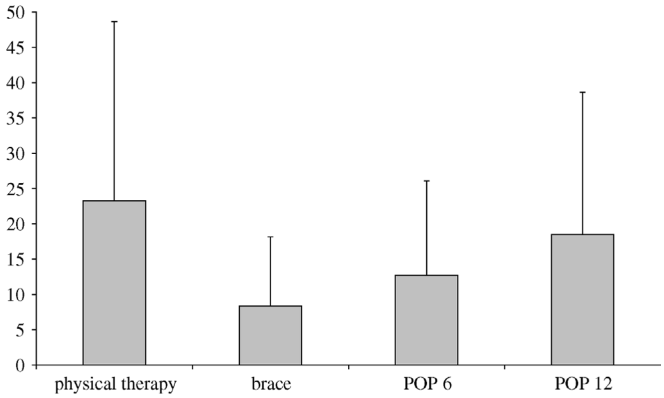

FIGURE 4. Compression fractures, all patients: mean ODI.

the compression fracture group had ODI scores of >40; 8 of these with an ODI of 60–80 and 1 with an ODI of 80–100. A multivariate analysis did not show any significant relationship with the type of treatment, fracture classification, or C measurements on the lateral radiographs. Prognostic factors of poor outcome could therefore not be identified.

In the burst fractures group, no patient had a VAS pain score higher than 70; 3 patients (12%) had a VAS score >50. One patient (4%) in the burst fracture group had an ODI of 76%. Multivariate analysis did not reveal significant prognostic parameters.

One patient in the burst group treated with a brace was operated on because of progressive deformity and pain 2 years after the traumatic event.

DISCUSSION

The first part of this study considered possible alterations in the measurements of the traumatic kyphosis after various treatments. Kuklo et al[17] and Dai and Jin[18] showed that the intra- and interobserver reliability of measurements on lateral radiographs and computed tomography scans vary but the C1 measurement as used in our study and the McCormack[19] classification are the most accurate. The Spine Study Trauma Group also included the Cobb angle (our C1 measurement) and the anterior vertebral compression percentage (our C4 measurement), the vertebral body translation percentage, and the sagittal to transverse canal diameter ratio in their list of recommended measurements for assessing thoracolumbar fractures.[15] If we had restricted our measurements to these recommended ones, our results would not have been different.

TABLE 4. Compression Fractures, All Patients; Summary of Significant Differences Between Treatments: Cross Table

	Physical Therapy	Brace	POP for 6 Wk	POP for 12 Wk
Physical therapy	—	—	VAS treatment	VAS treatment
Brace	ODI	—	VAS treatment	VAS pain ODI
POP for 6 wk	—	—	—	—
POP for 12 wk	—	—	—	—

TABLE 5. Patients With Thoracolumbar Junction Compression Fractures; Summary of Significant Differences Between Treatments: Cross Table

	Physical Therapy	Brace	POP for 6 Wk	POP for 12 Wk
Physical therapy	—	—	—	—
Brace	ODI	—	ODI	VAS pain ODI
POP for 6 wk	ODI	—	—	VAS pain
POP for 12 wk	—	—	—	—

Our observation that nonoperative treatment, using the methods described, does not significantly improve or, and more importantly, lead to deterioration in the final kyphosis angle is in agreement with the findings of Ohana et al[20] and Folman and Gepstein,[21] who treated patients with compression fractures functionally or with a brace. Alanay et al,[1] Agus et al,[7] and Wood et al[22] who investigated burst fractures treated nonoperatively, came to the same conclusions as did Tropiano et al[10] where burst fractures were reduced before application of the cast.

The VAS and ODI scores were more revealing. For patients with compression fractures, the scores of all the patients, of just those with thoracolumbar fractures, and of all patients after exclusion of the postmenopausal women indicated that the best of our treatment options is a brace for 6 weeks; for burst fractures, there was no difference between a brace or a POP. We did not separately analyze the results for the 2 groups of patients with fractures above T11 or below L2, as the numbers would have been too small.

These results are in contrast with Ohana et al[20] and Folman and Gepstein[21] who concluded that they did not see any difference in outcome between patients treated with a brace or functionally with physical therapy. Braun et al[8] also did not see a difference in outcome of patients treated functionally or with a 3-point brace. The difference in results may be explained by the retrospective nonrandomized nature of their studies compared with ours.

We wondered why for patients with compression fractures, brace treatment was better than a POP? Perhaps a removable brace provided the optimal combination of support, exercise, and comfort; in other words, the brace gave the patient sufficient spinal support, reduction of discomfort, and confidence to encourage exercise during the day while removal of the brace at night facilitated sleep and a feeling of general well-being.

The scores also showed disturbing features. According to the VAS, 20 (18%) of the 108 patients with compression

TABLE 6. All Patients With Compression Fractures, Except Postmenopausal Women; Summary of Significant Differences Between Treatments: Cross Table

	Physical Therapy	Brace	POP for 6 Wk	POP for 12 Wk
Physical therapy	—	—	VAS treatment	—
Brace	ODI	—	ODI	ODI
POP for 6 wk	—	—	—	—
POP for 12 wk	—	—	—	—

fractures suffered from moderate or severe back pain at long-term follow-up; 12 patients had an ODI score greater than 40 indicating moderate disability. Of the 25 patients with burst fracture, 3 (12%) had chronic moderate pain and one more was operated on because of severe persistent pain. Such chronic pain after the nonoperative treatment of thoracolumbar fractures has also been observed by other authors where treatments have varied from several weeks bed rest, different braces, and physiotherapy to supervised neglect.[2–6,9,21,23]

The multivariate analysis of our results unfortunately did not reveal any prognostic factors for persistent pain and disability. In particular, there was no association between final kyphosis measurements and residual pain, a fact that has also been noted by various other authors,[6,23–25] although Gertzbein[26] observed that a kyphotic deformity of greater than 30 degrees at 2-year follow-up was associated with an increased incidence of significant back pain. Folman and Gepstein studied 85 patients with a thoracolumbar vertebral wedge fracture treated with either physical therapy or a 3-point brace and found that 69.4% of the patients complained of chronic back pain, although there was no difference between the 2 nonoperative treatments.[21] The mean ODI for this patient group was 56.3, which is considerable higher than that of our population. He found a weak correlation between pain intensity and local kyphosis angle.

We should consider seriously the relatively high incidence of persistent pain, disability, and dissatisfaction after these relatively "minor" spinal injuries.[27] This incidence is much higher than seen after comparable injuries to the extremities. Almost 20% of patients suffering moderate to severe pain after a minor injury of the ankle, knee, or wrist would not be accepted as "good results." We should ask ourselves how we can predict these unsatisfactory results and whether we can prevent disability.

This study did have some drawbacks. First, the recruitment of patients was slow, 133 over almost 6 years, and this lead to a relatively small number of patients in each group, especially in the burst fracture group. However, these numbers were sufficient to show that there were no treatment-related statistically significant differences between the kyphosis measurements at the long-term follow-up and also to show that there were significant differences for the VAS and the ODI scores in the compression group. Second, patient compliance was not optimal, although the patients were well informed. The combined attendance at the long-term follow-up was 75%. We feel, however, that this has not resulted in a systematic bias because the random absentees applied equally to all groups. Third, patients' toleration of treatment, persistent pain, and disability were only recorded at the long-term follow-ups and not at the earlier controls as well, when they might have provided insight into how quickly patients could function independently after various treatments of a spinal fracture. Fourth, the percentage of postmenopausal women is relatively high and osteoporosis may have influenced the results. However, almost 80% of them had a high-energy trauma, and none of them had spontaneous back pain at inclusion; this probably excludes any true "spontaneous" osteoporotic fractures. Separate analyses also showed that the ODI was significantly better for brace therapy after exclusion of postmenopausal women.

We included patients with a thoracic or lumbar fracture, of whom 74% had a fracture of the thoracolumbar junction. The numbers of exclusively thoracic or lumbar fractures were too small to split our patient population in 3 groups. However, the number of patients with a fracture of the thoracolumbar junction was sufficient for separate analysis; brace therapy significantly had the best outcome on the ODI compared with the other treatment modalities.

Despite the fact that our study shows some methodologic flaws, it is one of the few studies that compares nonoperative treatment schemes based on a reasonable number of patients. A prospective, probably multicenter, study with inclusion of a sufficient number of patients would seem appropriate to search for the possible factors predicting poor outcome.

CONCLUSIONS

None of our nonoperative treatments had an effect on the post-traumatic kyphosis measurements. After a compression fracture, physical therapy alone is the most easily tolerated treatment. Brace treatment, however, results in the least residual pain and the least disability on the long term. Despite the fact that our study has some drawbacks, we tentatively recommend brace treatment as the treatment of choice for patients with moderate compression fractures of the thoracic and lumbar spine. For burst fractures, neither treatment had a clear advantage.

ACKNOWLEDGMENTS

We thank the staff of the Department of Surgery and Traumatology, St. Lucas Hospital, for contributing to this study. We thank Dr. C. Plasmans, orthopaedic surgeon, Onze Lieve Vrouwe Gasthuis, for his advice and encouragement at the inception of this study.

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